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DRAWINGS ATTACHED

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(54) DEREGISTERING CRIMP IN A CRIMPED MULTI FILAMENT TOW

(71) We, KIMBERLY-CLARK CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of Neenah, Wisconsin, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for deregistering crimped, continuous filament tow.

Textile tow may be made up of continuous, parallel, crimped, synthetically spun filaments, such as from 500 to 5,000,000 filaments, and may be prepared by grouping in parallel relationship the filaments spun from a plurality of spinnerette holes. The individual filaments or groups of filaments may be crimped before being combined, but the preferred method of making such crimped tow is to first form the tow and then run it through a crimping device.

The crimped tow may be used for many purposes in the form of continuous filaments without being cut into staple form; and, in this case, the continuous filaments generally are much more useful if they have an open structure in which large numbers of filaments are spaced from adjacent filaments and if the spacing is such that there is a uniform distribution of filaments transversely of the tow. One reason for crimping the filaments is so that when the crimps are deregistered, they provide the internal pressure in the tow for causing the tow to expand transversely, in order to make a wide web having an even distribution of filaments transversely. It is nearly impossible to cause the uniform spreading of straight filaments; and, the more crimps that are in the tow, the better is the distribution of filaments when the crimps are deregistered and the tow is in a tension relaxed condition. The crimped tow when it comes from the manufacturer has waves in it which are in register, so that the surface of it looks much like the wave in water, but when the crimps in the tow are deregistered, the crimps have a knuckle to knuckle contacting relation and balloon the tow out into a much greater width.

In a method of deregistering crimped tow in accordance with the invention, the crimped multi-filament tow is longitudinally pulled over a plurality of stationary bars under tension, moving other bars in contact with the tow after it has left said stationary bars in a direction opposite to the direction of movement of the tow, and subsequently passing the tow in pressure contact with a drafting roll while rotating the drafting roll at a slower speed than the speed of movement of the tow. Initial deregistration of the crimped filaments is obtained by the frictional effect of the tension bars on the tow while the tow is held under tension, tending to straighten out the crimps in the tow. The subsequent beating step provides additional deregistration of the crimped filaments while the filaments remain under tension. The first pair of rolls preferably include a resilient surfaced roll having a pressure nip with a fluted steel roll and the tow is pulled through this pressure nip by the second pair of rolls so that the fluted roll of the first pair has a brushing or wiping action on the bundle of tow causing additional deregistration of the crimps in the tow.

An embodiment of apparatus in accordance with the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a plan view of the apparatus for deregistering crimped filamentary tow;

Figure 2 is a side elevational view of the apparatus; and

Figures 3 and 4 are sectional views taken on lines 3—3 and 4—4 of Figure 1.

Referring to the drawings, the apparatus for deregistering tow comprises generally a tension bar section 10, a beating section 11 and a drafting section 12.

The tow 13 to be processed by the apparatus

[Price 25p]

of the invention may be withdrawn from any suitable tow container 14, and the apparatus may include an inclined chute 15 over which the tow is drawn from the container 14.

The tow 13 passes from the chute 15 to the tension bar section 10, and the tension bar section comprises bars 16 to 24. The bars 16 to 24 are supported from a support frame 25, the bars after 16 being supported in pairs. The bar 16 is disposed between a pair of opposite arms 26 and 27, and these arms are fixed to opposite vertical struts 28 and 29 that in turn are fixed to the frame 25. The bars 17 and 18 are supported as a pair between the opposite ends of arms 30 and 31, and these arms are fixed to opposite vertical struts 32 and 33 that are in turn fixed to the frame 25.

The bars 19 and 20, the bars 21 and 22 and the bars 23 and 24 are also supported in pairs from the frame 25 in the same manner as are the bars 17 and 18; namely, by means of arms 30a, 30b and 30c on one side of the frame 25; arms 31a, 31b and 31c on the other side of the frame 25; vertical struts 32a, 32b and 32c on one side of the frame 25; and vertical struts 33a, 33b and 33c on the other side of the frame.

The tow 13 passes consecutively over and under the tension bars 16 to 24 in the direction indicated by the arrow A. It will be observed from Fig. 2 that the arms 30 and 31 and therefore, the bar 18 with respect to the bar 17, are declined at about an angle of 35° in the direction A measured from the plane of the frame 25; the arms 30a and 31a and therefore, the bar 20 with respect to the bar 19, are declined about 10° in the direction A measured from this plane; the arms 30b and 31b and therefore, the bar 22 with respect to the bar 21, are declined at about an angle of 50° measured from this plane; and the arms 30c and 31c and therefore, the bar 24 with respect to the bar 23, are declined at about an angle of 20° measured from this plane. The tow is drawn from the chute 15 and passes initially over and in contact with the tension bar 16. The tow then contacts and passes over the bar 17 and under the bar 18, over the bar 19 and under the bar 20, over the bar 21 and under the bar 22 and over the bar 23 and then finally under the bar 24.

The beating section 11 comprises a plurality of bars 34a, 34b, 34c and 34d extending between the outer peripheral edges of a pair of discs 35 and 36 so as together to form a cage. The discs 35 and 36 are rotatably supported within a frame 37 and are driven from any suitable prime mover, such as the motor 38 and transmission unit 39, whereby the discs 35 and 36 and bar 34a to 34d rotate in the direction indicated by the arrow B.

The drafting section comprises a steel roll 40 having a nip with a rubber roll 41 and a pair of steel rolls 42 and 43. As will be observed, particularly from Figs. 3 and 4, the rolls 40, 42 and 43 have longitudinally extending flutes on their external surfaces, and the flutes of the rolls 42 and 43 intermesh. The rolls 40 to 43 are rotatably disposed in a frame 44, and any suitable driving apparatus and gearing 45 may be provided for driving the roll 40 at a relatively slow speed and for driving the roll 42 and thereby the roll 43 at a higher speed.

In operation, the tow from the tow container 14 is drawn over the chute 15, over and under the various tension bars 16 to 24, over the bars 34a to 34d of the beating section 11 and through the nip of the rolls 40 and 41 by the action of the rolls 42 and 43 which act as pull rolls. The tow thus is under some tension as it passes through the tension bar section 10, and the tension in itself has the function of not only straightening out the crimps in the filaments somewhat but also of moving some of the crimps in the tow filaments out of register, particularly on subsequent relaxations of tension as occur a number of times for each revolution of the discs 35 and 36 in the beating section 11 and as also occur to some extent in the tension bar section 10 subsequent to the bar 16 and subsequent to each of the tension bar pairs 17—18, 19—20, etc. The tow as it passes over each of the tension bars 16 to 24 also has its crimps deregistered due to the friction between the filaments of the tow and each of the tension bars. Each of the tension bars is in frictional contact with only some of the filaments in the tow; and, therefore, there is a skating action or relative movement of the particular filaments in contact with the tension bar with respect to the other filaments in the tow that are not in contact with the particular tension bar. It will be noticed that some of the tension bars 16 to 24 are in contact with the upper surface of the tow while others are in contact with the lower surface of the tow; and, therefore, the bars are in contact with different filaments as the filaments proceed over the tension bars due to this reason. Also, the filaments tend to shift in the tow, moving from external surfaces of the tow to inside the tow as the tow moves through the tension bar section 10; and, for this additional reason, the various tension bars are in contact with different filaments as the tow passes over the tension bars so that frictional retardation on different ones of the filaments is exerted by the different tension bars, causing deregistration of crimps due to this action also. An additional crimp deregistering action of the tension bars is due to the fact that the tow has a substantial thickness as it passes over each of the tension bars; and, therefore, the filaments on the outside, away from the surface of the particular tension bar over which the tow is passing, passes around the bar at a greater radius than the filaments closer to the center of the tension bar. There thus is a difference in speed of the filaments due to the different radii at

which the filaments are disposed as the tow passes over each of the tension bars also tending to cause different filaments to skate or move with respect to other filaments and providing crimp deregistration.

The bars 34a to 34d of the beating section 11 have intermittent frictional contact with the inner surface of the tow; and, due to the substantial spacing of the bars 34a to 34d from each other, there is an intermittent relaxation of tension on the filaments of the tow as the bars 34a to 34d pass their zenith. These relaxations of tension allow the crimps to tend to return to their original relatively tightly curved condition; and, in conjunction with the tension that is provided on the tow in both of the sections 10 and 11, this intermittent relaxation of tension provides a crimp deregistering action and fluffing of the tow. Each of the bars 34a to 34d of the beating section 11 also has a frictional action on the particular filaments on the inside surface of the tow, and this frictional effect of the bars 34a to 34d causes a skating action or relative movement of the inner filaments to occur with respect to the other filaments in the tow providing a deregistering action, this action being similar to the crimp deregistering action by each of the tension bars 16 to 24 and being cumulative with respect to the deregistering action of the bars 16 to 24. Since the bars 34a to 34d move in the direction opposite to that of the tow, their frictional effect on the tow is greater than the bars 16 to 24; and the moving bars 34a to 34d thus provide a subsequent greater deregistering action on the crimps after the crimps have been initially deregistered to some extent by the stationary tension bars 16 to 24. Since the deregistering action is cumulative through the sections 10 and 11, the tow 13 expands generally as it passes through the sections 10 and 11 inasmuch as the crimps when out of register exert pressure on each other sidewise of the tow tending to increase the width of the tow. The tow has a relatively narrow width in the tension bar section 10 due to the tension that is exerted on the tow as it passes through the section 10.

The tow as partially deregistered in the tension bar section 10 and in the beating section 11 is further deregistered by the action of the fluted steel rolls 40, 42 and 43. The rolls 42 and 43 have a substantially higher peripheral speed than the roll 40, which is driven by the same gearing 45 as is the fluted roll 42; and which acts with the roll 41 forcefully to regard the tow. Therefore, the tow is pulled through the nip between the rolls 40 and 41 and is stretched between the roll pair 40—41 and the roll pair 42—43, so that the tension on the tow is substantially greater between these roll pairs than the tension on the tow in the apparatus prior to the roll pair 40—41. The rubber roll 41 is maintained with a certain pressure on the fluted roll 40; however, this pressure is not sufficient to prevent the pulling of the tow through the roll pair 40—41. The tow, in being pulled between the roll pair 40—41, has its crimps deregistered to an increased extent; and the fluted roll 40 has a wiping and brushing action on the tow in causing such further deregistration of the crimps. The roll 40 is driven at a fixed reduced speed with respect to the rolls 42 and 43; however, since the rubber roll 41 is not geared with respect to any of the fluted rolls, the roll 41 has a peripheral speed substantially the same as the tow as it passes through the nip of the roll pair 40—41. There thus is a difference in speed of the two rolls 40 and 41 exerting substantial frictional forces respectively on the lower and upper surfaces of the tow as it passes between the rolls 40 and 41, and the roll 40 causes the filaments particularly in contact with it to move and skate with respect to the other filaments in the tow to thus provide a crimp deregistering action.

Although the rolls 42 and 43 function as pull rolls for pulling the tow through the sections 10, 11 and 12, the rolls 42 and 43 are not in forceful contact with each other and are only partially meshed. The rolls 42 and 43 travel at a higher peripheral speed than the speed of the tow as it passes between these rolls, and the flutes of the rolls 42 and 43 thus exert a brushing and crimp deregistering action on the filaments of the tow. The fluted rolls 42 and 43 are respectively in contact with the filaments on the lower surface and the upper surface of the tow passing between the rolls 42 and 43; and thus these rolls also cause a skating action or movement of the filaments on the upper and lower surfaces of the tow with respect to the filaments inside the tow to provide a further crimp deregistering action. Tension is completely relaxed on the tow after it leaves the rolls 42 and 43, and the tow balloons sidewise to a very much greater width than when it is passing through the machine, as is indicated in Fig. 1. The crimps of most of the filaments in the tow at this time rebend back to much their original shape but they are out of register and exert a sideways force on the tow tending to cause this outward ballooning due to the knuckle to knuckle contact of the crimps. With respect to the tow speed as it passes through the drafting section 12, this speed is the same as the peripheral speed of the roll 41 and is intermediate the peripheral speed of the roll 40 and the peripheral speed of the rolls 42 and 43.

It will be noted that the various sections 10, 11 and 12 all utilize the frictional action of members on the tow with a relative speed difference between the tow and the friction members and that in all of these sections there is tension on the tow tending to straighten the crimps in the individual filaments. The tension section 10 is particularly effective on a heavy batt of the filamentary tow in the condition

in which it first leaves the container 14, and this is due to the low relative speed between the tow and the stationary bars 16 to 24. The relative difference in speed between the bars 34a to 34d of the beating section and the tow is greater, since the bars 34a to 34d to 36d move beneath and in contact with the tow in a direction opposite to the direction of tow movement; and the beating section, therefore, is particularly adapted for and is effective on the tow after it has been preliminarily deregistered and after the tow has been made somewhat lighter in the tension bar section. Each of the bars 34a to 34d, like the bars 16 to 24 of the tension bar section 10, has a frictional action on the tow, as tension is maintained on the tow, tending to rub the crimps out of register; and after the crimps pass over the respective bars, the filaments tend to twist so that their crimps tend to turn in diverse directions to be no longer in register.

The drafting section 12 is particularly effective on the tow after it has been preliminarily tensioned and deregistered in the sections 10 and 11 and after the tow has been somewhat stretched and made lighter. The drafting section 12 is thus positioned to be effective on the tow after the initial deregistration by the sections 10 and 11. The deregistration in the drafting section 12 is due principally to the increased tension that is put onto the tow between the roll pair 40—41 and the roll pair 42—43 and due to the wiping, brushing action on the tow as it passes over the flutes of the rolls 40, 42 and 43. The drafting section 12 thus completes the deregistration of the crimps so that, when the crimps attempt to re-form with their original curvatures after tension is released on the tow as it passes between the rolls 42 and 43, the crimps extend in diverse directions with haphazard turning and twisting of the individual filaments with respect to the planes of the nips of the rolls 40 to 43, so that the crimps give an internal pressure to the tow, with one crimp knuckle contacting and working against another and so that the tow is bloomed or expanded transversely. The tow as so bloomed may be used in this condition, or may be subsequently spread out further, so as to form a very wide web, by any suitable conventional tow spreading apparatus.

Although filamentary tow may be run through the apparatus at many different speeds, deregistering action has been found, for example, to occur satisfactorily at a speed of 50 feet per minute as the tow emerges from between the final roll pair 42—43. The beating section 11 may be run at many different speeds with a satisfactory deregistering effect; however, we have found that if the bars 34a to 34d are rotated in the direction reverse to the movement of the tow at 25 to 50 revolutions per minute, with the bars for example being on a radius of six inches, satisfactory operation occurs. It is not necessary or desirable for satisfactory operation that the rolls 42 and 43 be in forceful contact with each other; and it has been found that the intermeshing flutes of the rolls 42 and 43, with these rolls being only in partial engagement, have the effect of pulling the tow with substantial slippage, and inherent filament brushing is obtained between the rolls 42 and 43. In order that there may be the above described wiping brushing action by the fluted roll 40, we have found that the roll 41 may be applied with a pressure onto the roll 40 of about four pounds per lineal inch, for example. The speed of the rolls 42—43 is preferably at least twice the speed of the roll 40, and very satisfactory operation has been had with the rolls 42 and 43 rotating at about three times the speed of the roll 40. As previously mentioned, the rubber roll 41 rotates at a peripheral speed which is about equal to the speed of the tow, greater than the speed of roll 40 and less than that of rolls 42 and 43.

WHAT WE CLAIM IS:—

1. A method of deregistering the crimps in crimped multi-filament tow, comprising longitudinally pulling the crimped multi-filament tow over a plurality of stationary bars under tension, moving other bars in contact with the tow after it has left said stationary bars in a direction opposite to the direction of movement of the tow, and subsequently passing the tow in pressure contact with a drafting roll while rotating the drafting roll at a slower speed than the speed of movement of the tow.

2. A method as claimed in Claim 1, in which the movable bars are moved at a speed greater than the speed of movement of the tow in the opposite direction.

3. A method as claimed in either of the preceding claims including the step of forcefully retarding the tow after it passes over the bars for the purpose of applying increased tension onto the tow.

4. A method as claimed in any of the preceding claims including the additional step of passing the tow between a pair of partially intermeshed drafting rolls after the tow passes from the first named drafting roll while rotating the pair of drafting rolls at a higher speed than the first named drafting roll and at a higher speed than the speed of movement of the tow.

5. A method as claimed in Claim 4 in which the drafting rolls are fluted.

6. Apparatus for deregistering crimped multi-filament tow comprising a plurality of stationary bars, means for pulling the multi-filament tow over the bars under tension conditions, and a beating apparatus having a plurality of protrusions and effective on the tow between the pulling means and the bars, and means for rotating said protrusions while in contact with a surface of the tow in a direction

opposite to the direction of movement of the tow.

7. A deregistering apparatus as claimed in Claim 6 in which the movable protrusions constitute bars in a rotatable cage, and including means for rotating the cage so that the bars move in contact with the tow in the direction opposite to the movement of the tow.

9. A deregistering apparatus for crimped multi-filament tow as claimed in either claim 6 or 7 in which the pulling means include a pair of nipped rolls between which the multi-filament tow is passed, and a second pair of nipped rolls between which the tow is passed and effective on the tow prior to its passage between the first named pair of rolls, means for driving one of the first named pair of rolls at a certain speed and means for driving one of the second named pair of rolls at a lower speed so as to increase the tension on the tow as it passes from the second roll pair to the first roll pair.

9. A deregistering apparatus for crimped multi-filament tow as claimed in Claim 8, in which the second named roll pair include a fluted metal roll and a resilient roll held in pressure contact with the fluted roll with such a pressure that the tow may slip between the two rolls.

10. A method of deregistering the crimps in crimped multi-filament tow, substantially as hereinbefore described.

11. Apparatus for deregistering crimped multi-filament tow, substantially as hereinbefore described, with reference to the accompanying drawings.

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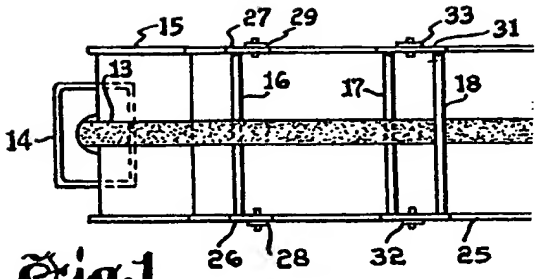

Fig. 1

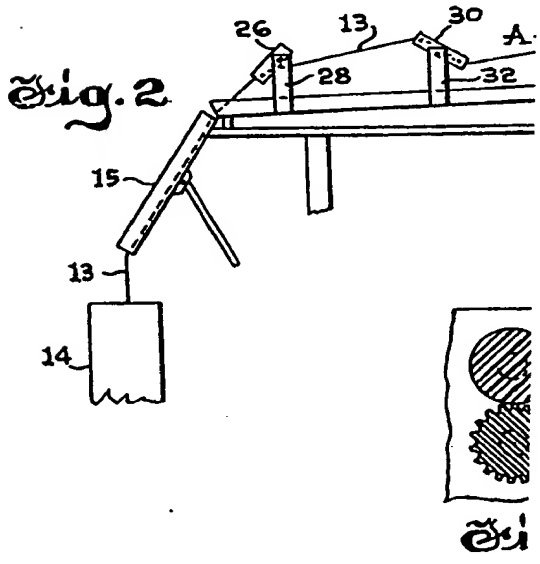

Fig. 2

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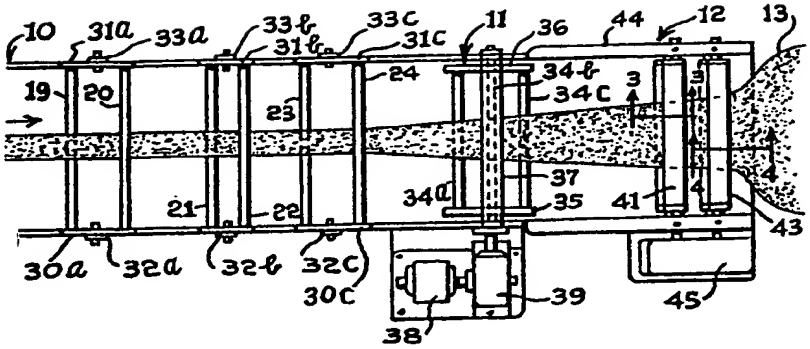

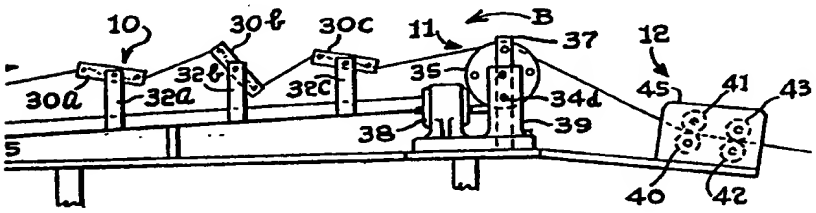

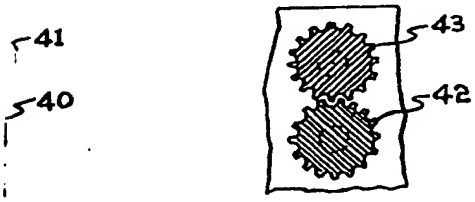

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Fig. 4

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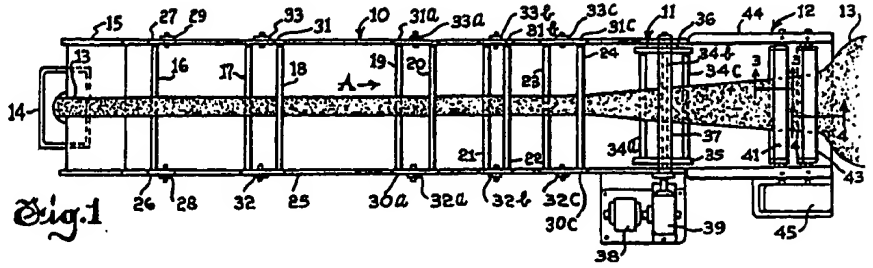

Fig.1

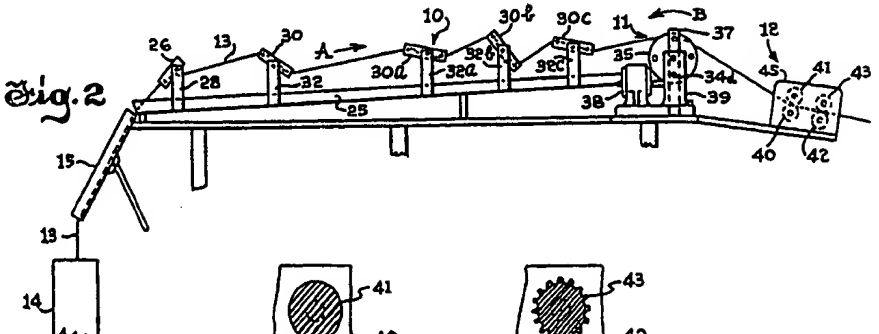

Fig.2

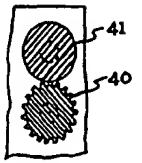

Fig.3

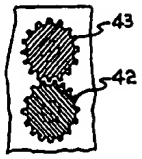

Fig.4